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Optimization of stirrer speed on mechanical properties of aluminium graphite stir cast

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Abstract

Using a stir casting method and changing the speed of the stirrer, a lubricant-like metal matrix composite is made and tested for its mechanical properties. A stainless steel stirrer is used to thoroughly combine the alloy and graphite. Once the alloy and reinforcement have been combined into a single, red-hot mass, the stirrer is spun at 200rpm. The molten metal now exits from the bottom of the furnace along the machine's track. To prevent molten solidification along the route, the temperature is kept at 550°C. The route transports the molt to a die, where the die is broken apart and the mold is removed. To prevent the alloy from clinging to the walls, non-stick paste is applied to the die, furnace, and walkway. The procedure is repeated for stirrer speeds of 400, 600, and 800rpm, and the best stirrer speed is determined by comparing the mechanical characteristics of each speed. The major goal of this project is to create a metal matrix composite made of Al-Si alloy and graphite that is cast together using the stir casting process by adjusting the stirrer speed. This is designed specifically for casting alloys and reinforcements together as a composite. Then the casted

alloys are compared with each other by determining their hardness, compression, wear behavior, tensile strength, and micro structure to optimize the best stirrer speed.

Introduction

A composite material is made by fusing together two or more materials that usually have very different properties [1]. The two components combine to give the composite its distinct features. However, because the elements do not disintegrate or blend together, you can readily discern them individually inside the composite [2]. Many investigations have been carried out using different filler materials and the study of their different properties [3], [4], [5], [6]. To a large degree, metal-coated reinforcements have been able to overcome these constraints. The squeeze casting process was used to create NCG particles that reinforced an Al6061 matrix with varying weight percentages. Sample was prepared and analyzed with reinforcement additions of different concentrations[7]. According to the findings, tensions increase during the early stages of deformation before becoming less compressive as bulging takes shape [8]. The two alloys were subjected to a series of tests with compound impact loading. Another important factor is relative sliding velocity, and it has been demonstrated that peak impulsive stress has a significant influence on wear rates [6]. The molten alloy is poured straight into the die without being pressed. The mold is taken when the die is split. The coating is completed before the next casting [9]. The composites containing 2.5% SiC have achieved higher hardness. The effect of sintering temperature on the micro structure and characteristics of Al_2O_3-SiC composites has been attempted [10]. Fine-sized reinforcements can limit dynamic micro structures during fatigue because of the obstacles to grain formation and crack propagation [11]. In terms of physical attributes, strengthening in metal matrix composites has been linked to highly dense dislocations in the matrix caused by differential thermal contraction, geometrical limitations, and plastic deformation during processing [12]. Before the following casting, a coating is completed. Squeeze casting is used to cast materials made of Al-Si alloy and graphite powder. The objective of this work is to focus mainly on the production of Al-Si/graphite composites and the relationship between their structure and properties. Aluminum-silicon alloys and their composites reinforced with graphite (3wt%) particles have been studied for their mechanical and wear characteristics.

Section snippets

Materials and preparation

Aluminum, an atomic number 13 chemical element with the symbol Al, is a member of the boron group. It is a silvery-white, ductile metal. In the crust of the earth, aluminum is the most common metal and the third most abundant element. LM6 has high corrosion resistance under both typical atmospheric and marine environments and complies with BS 1490, shown in Fig. 1. Anodic therapy can improve this feature in the worst circumstances.

Aluminum-silicon alloys may be used to make intricate castings

Tensile tests

The tensile test for the substrates is carried out and reported in Table 2. The various substrates prepared and their respective tensile strengths are considered. The stirrer speed varies from 0 to 800 rpm. From the table, it is noted that the stirrer speed maintained at 600 rpm gives the best result at 187 MPa.

Compression test

The compression test for the substrates is carried out and reported in Table 3. The various substrates prepared and their respective compression strengths are considered. The stirrer

Conclusion

By examining the micro structure of the aluminum graphite composites, the composite with a stirrer speed of 600 rpm has a better distribution of graphite. The hardness, compression strength, and tensile strength are high at 600 rpm. Therefore, the wear test is conducted for the particular specimen, which is cast at the stirrer speed of 600 rpm, which shows that as the sliding distance increases, the weight loss and wear volume loss tend to increase. The wear rate tends to decrease as the

CRediT authorship contribution statement

S. Arunkumar: Investigation, Writing – original draft. **Ch. Siva Ramakrishna:** Methodology, Writing – review & editing. **M.S. Alphin:** Conceptualization, Formal analysis. **R. Muraliraja:** Writing – review & editing. **T. Vinod Kumar:** Supervision, Formal analysis. **Bhaskar Vishwakarma:** Writing – review & editing. **Vandana Agrawal:** Supervision, Formal analysis. **Anil Singh Yadav:** Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References (13)

A. Agrawal *et al.*
Physical and mechanical behaviour of epoxy/hexagonal boron nitride/short sisal fiber hybrid composites
Mater. Today Proc. (2020)

R. Khanna *et al.*
WEDM of Al/SiC/Ti composite: a hybrid approach of RSM-ARAS-TLBO algorithm
Int. J. Light. Mater. Manuf. (2022)

A. Girge *et al.*
Industrial waste filled polymer composites–a review
Mater. Today Proc. (2021)

P.K. Rohatgi *et al.*
Effect of microstructure and mechanical properties on the seizure resistance of cast aluminium alloys
Wear (1974)

S. Biswas *et al.*
Tribological properties of cast graphitic-aluminium composites
Tribol. Int. (1983)

A. Sharma *et al.*

Micro-drill on Al/SiC composite by EDD process: an RSM-MOGOA based hybrid approach

Int. J. Light. Mater. Manuf. (2022)

There are more references available in the full text version of this article.

Cited by (1)

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